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Fukuta et al.

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(54) **DEVELOPING DEVICE HAVING REGULATING PORTIONS THAT REGULATE MOVEMENT OF A SEAL MEMBER**

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G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0898*** (2013.01); ***G03G 15/0812*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0886; G03G 15/0881; G03G 15/0812; G03G 15/0898
USPC 399/102, 106
See application file for complete search history.

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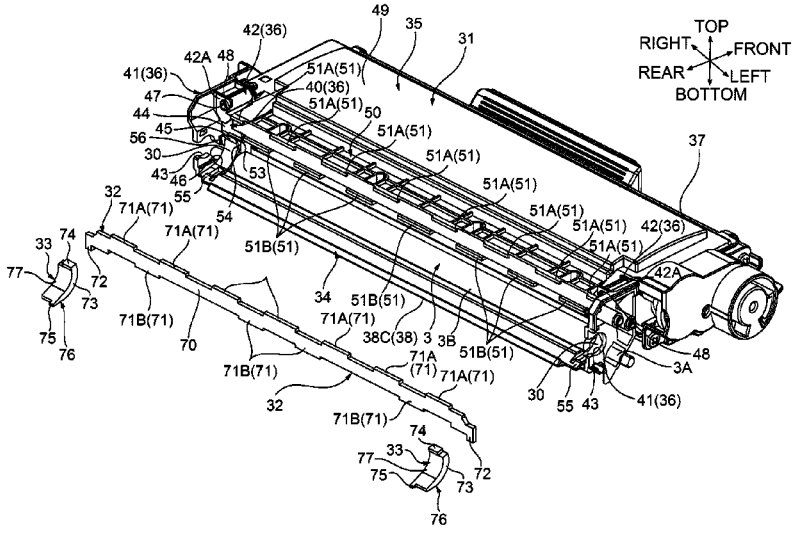
(57) **ABSTRACT**

A developing device includes a casing configured to store a developing agent and a developing agent carrier configured to carry the developing agent in the casing. The developing agent carrier is configured to rotate about an axis extending in a first direction. The developing device further includes a layer-thickness regulating member configured to regulate a thickness of a layer of the developing agent carried on the developing agent carrier and a first seal member disposed between the layer-thickness regulating blade and the casing. The first seal member extends along the first direction. The casing includes a first regulating portion configured to regulate a movement of the first seal member in the first direction by contacting a surface of the first seal member non-parallel to the first direction. The first regulating portion may include protrusions and/or indentations to regulate the movement of the first seal member.

40 Claims, 11 Drawing Sheets



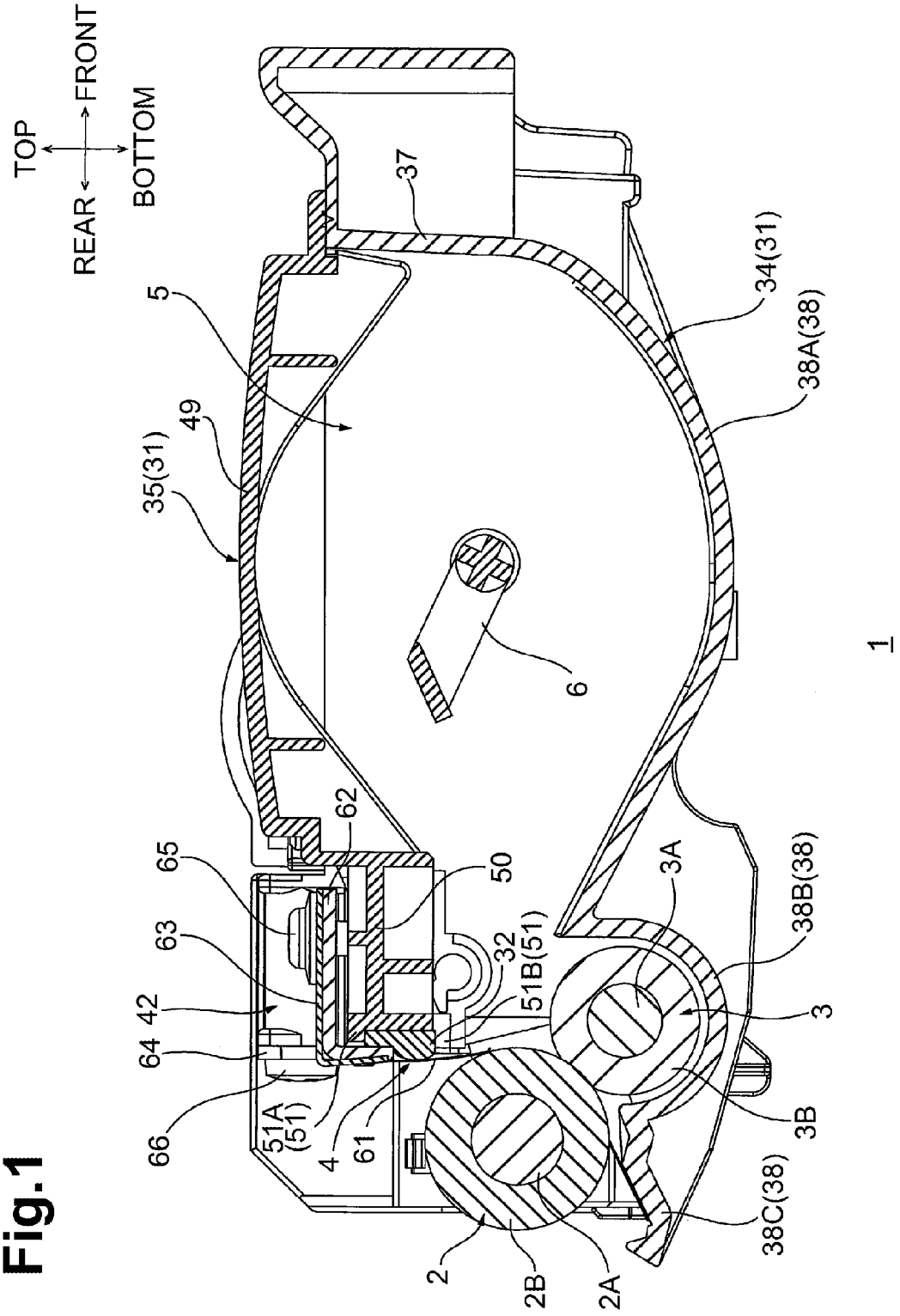

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Fig.1

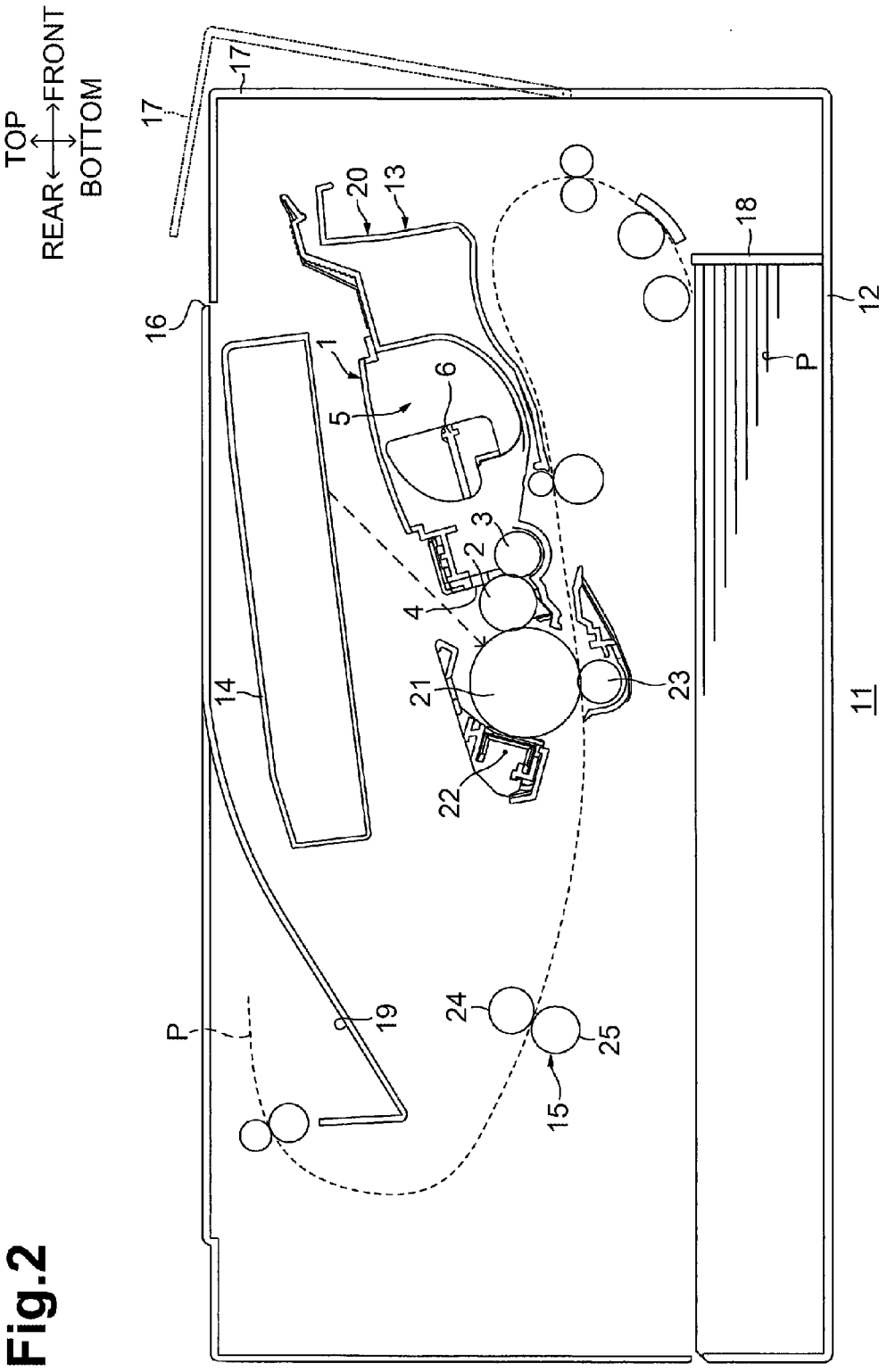
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Fig.2

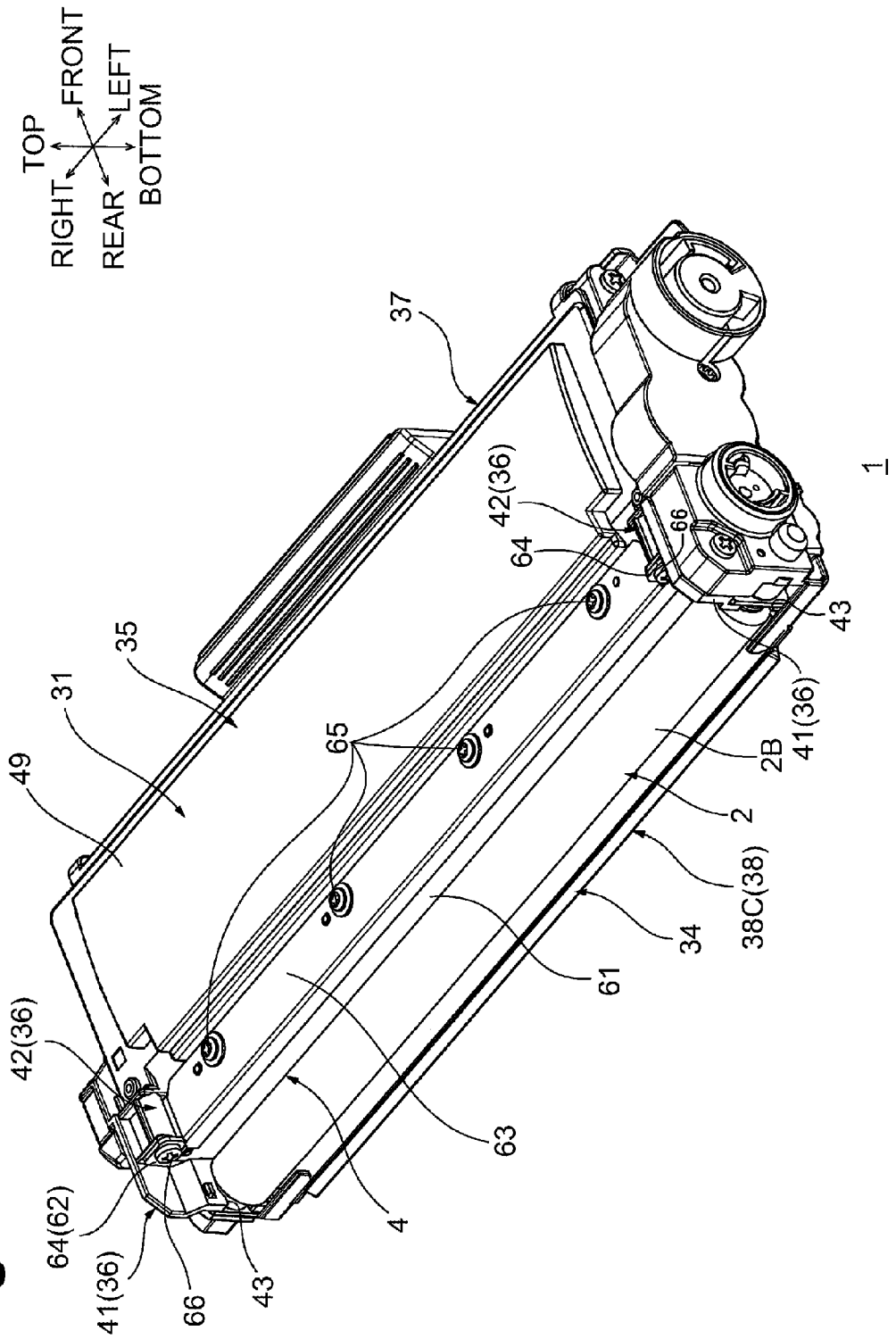
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Fig.3

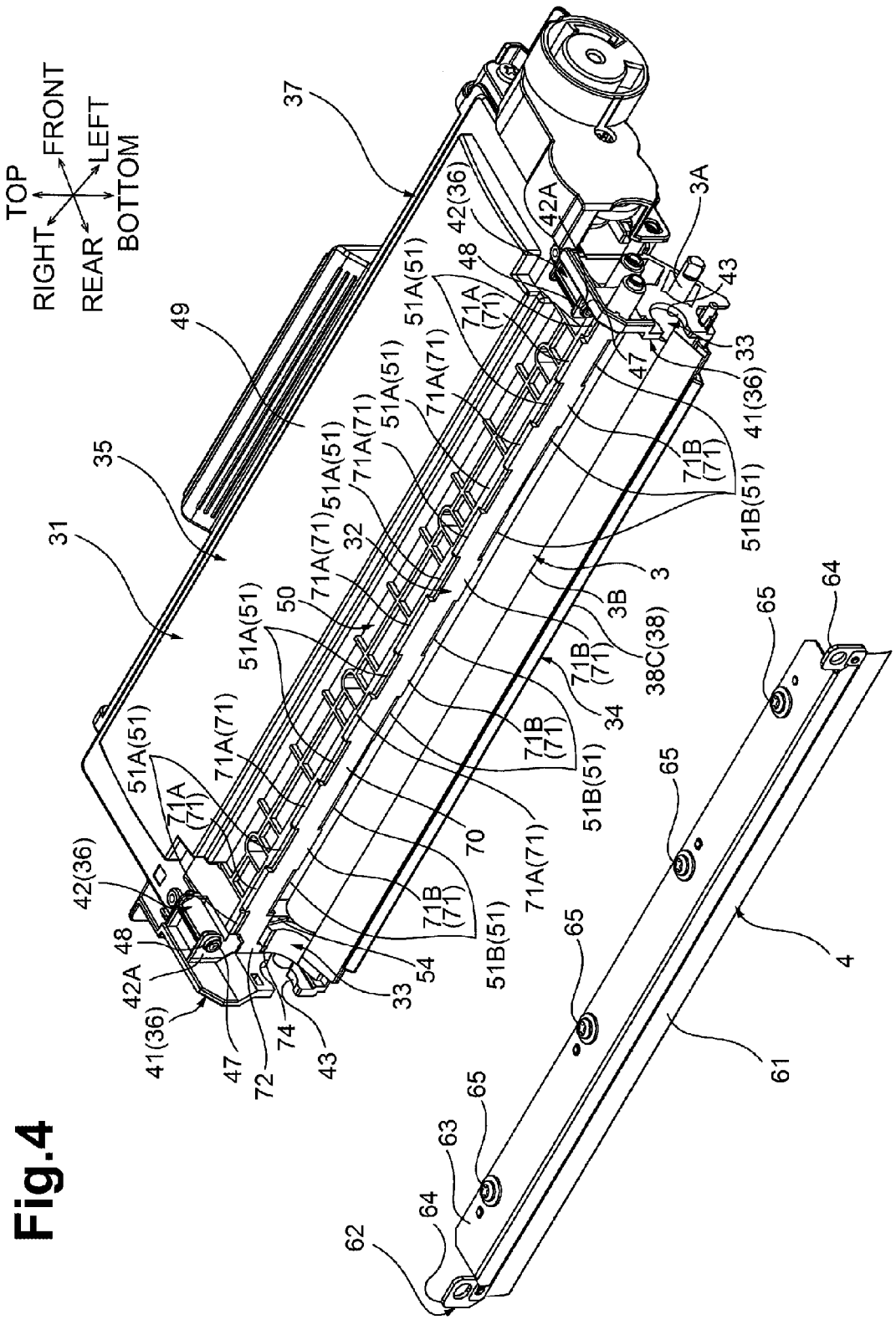
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Fig.4

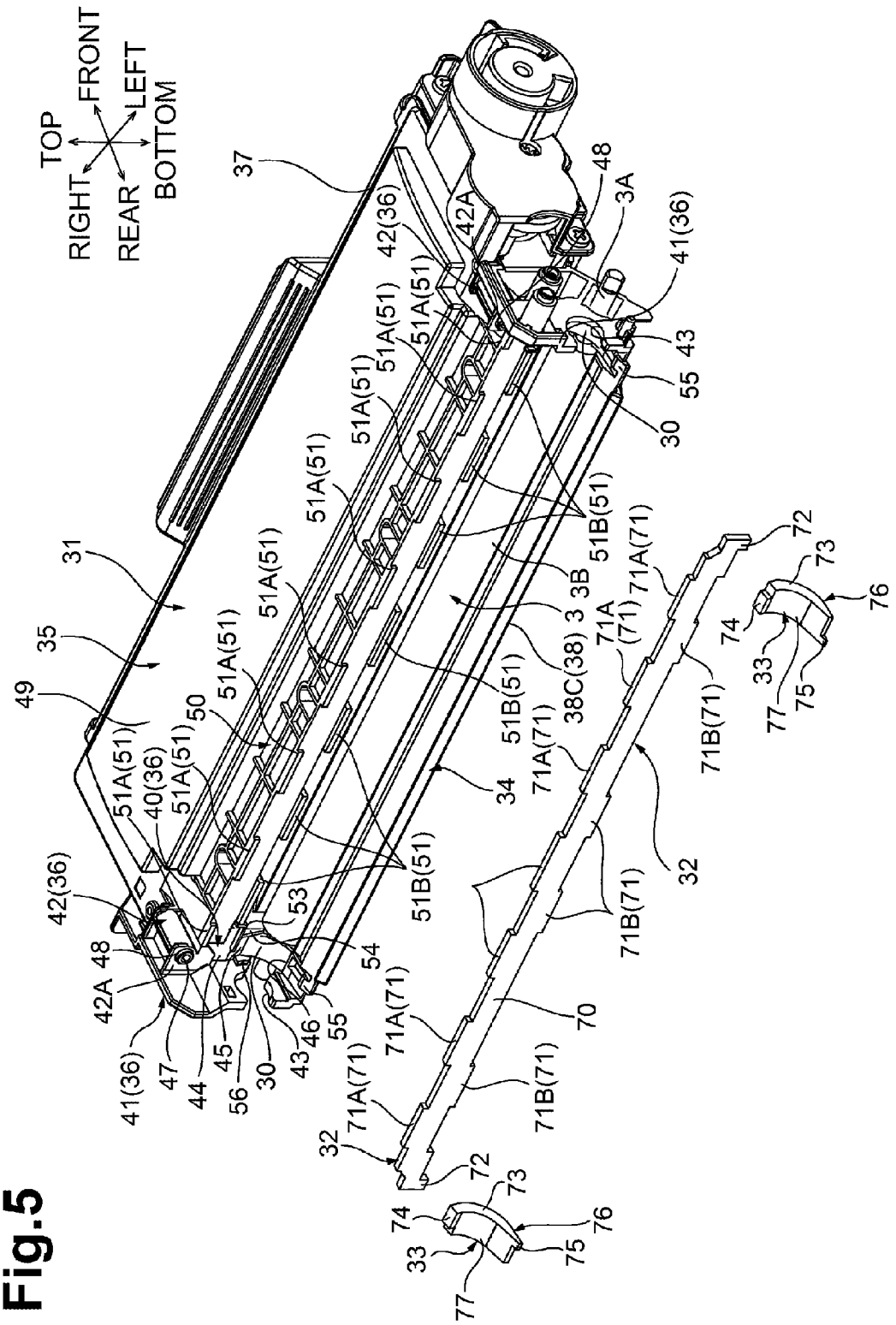
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Fig.5

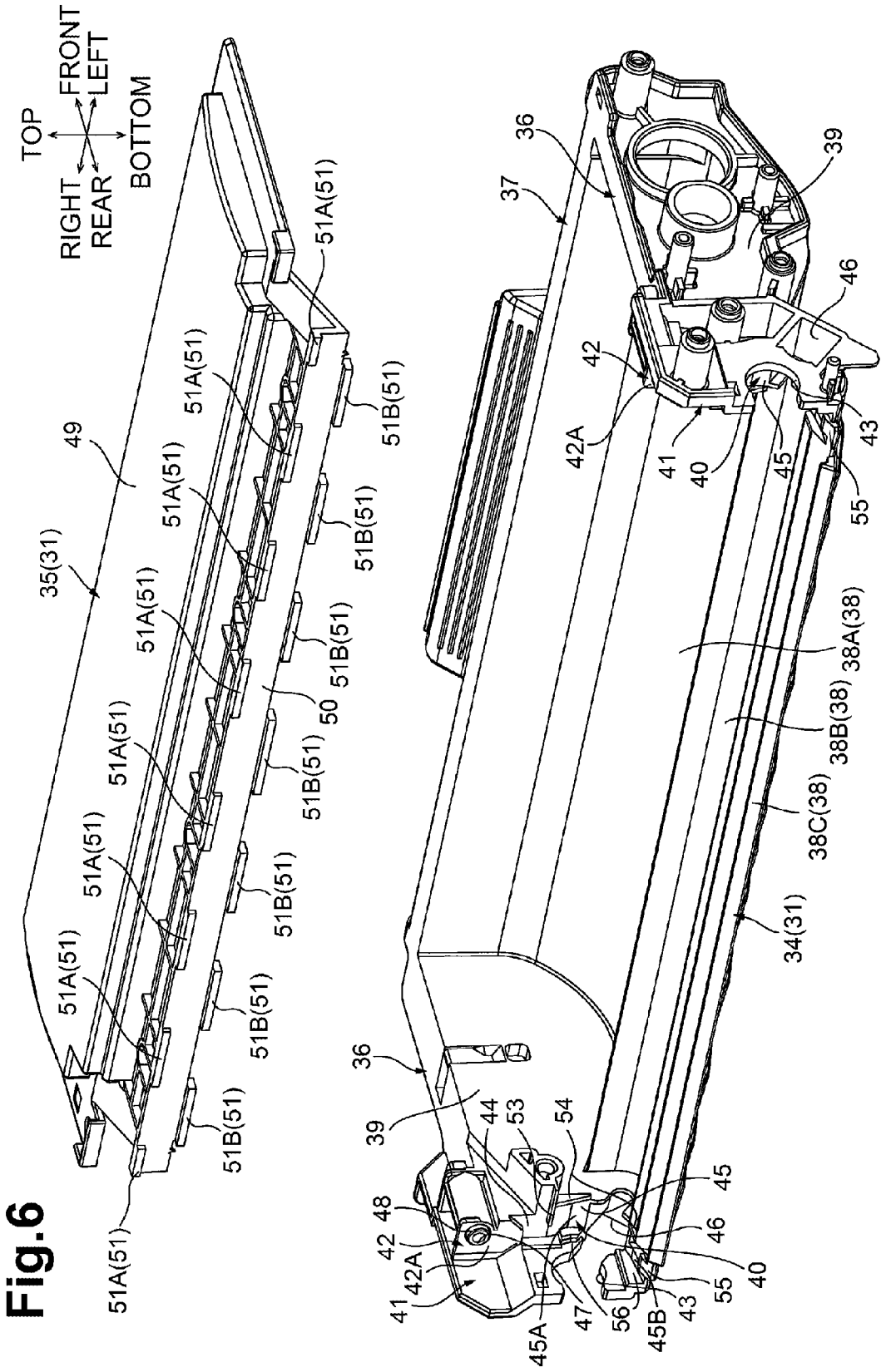
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Fig.6

Fig.7

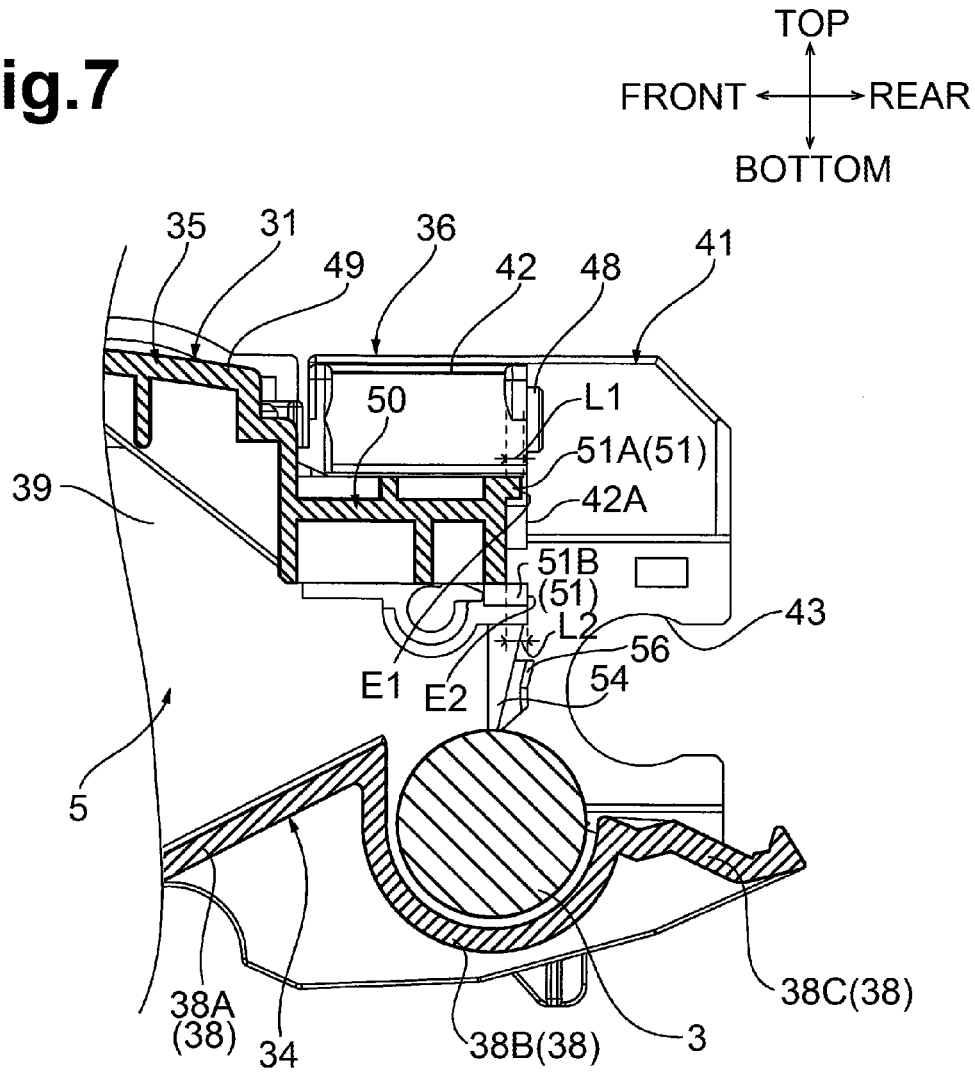
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Fig.8

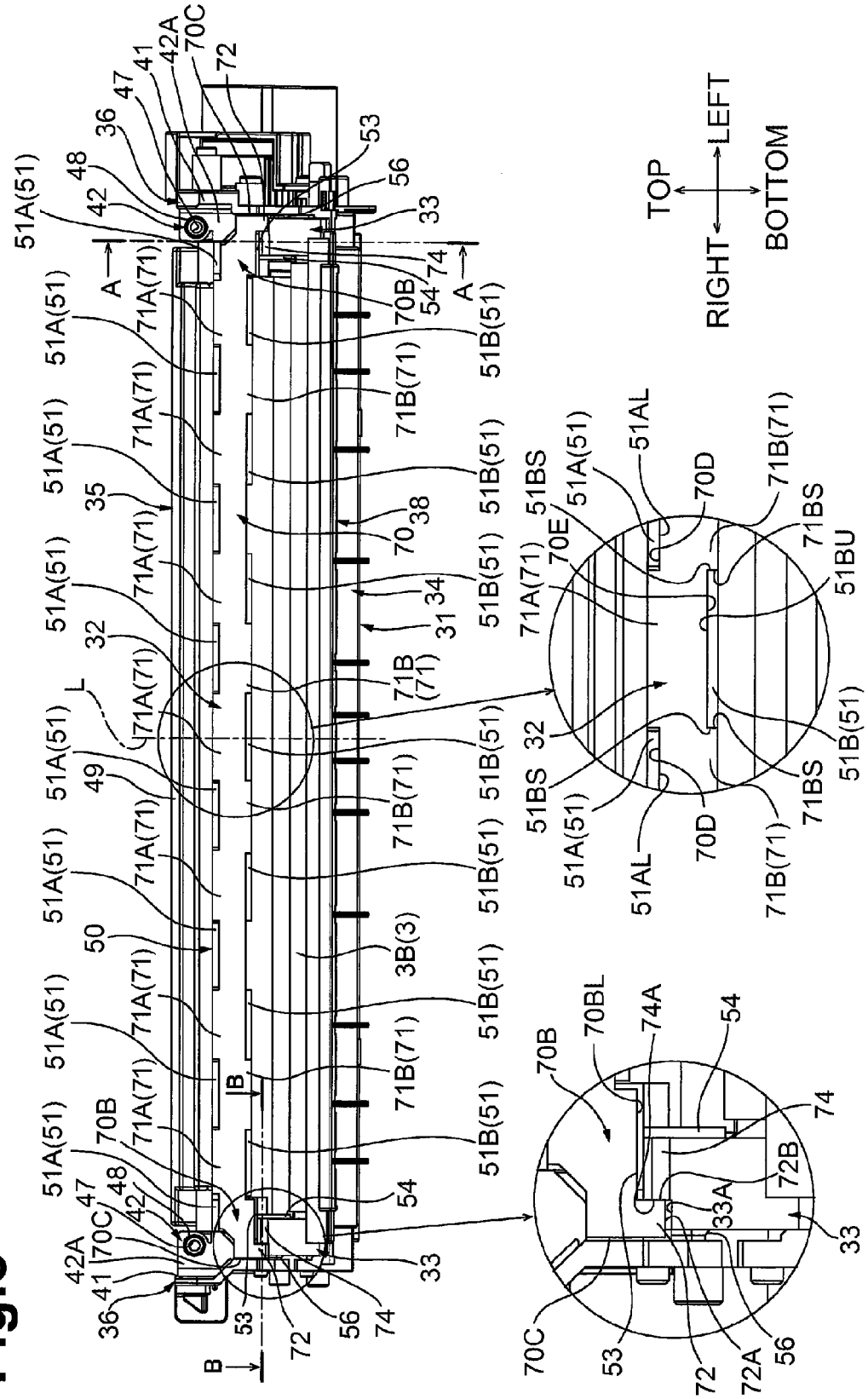
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Fig.9A

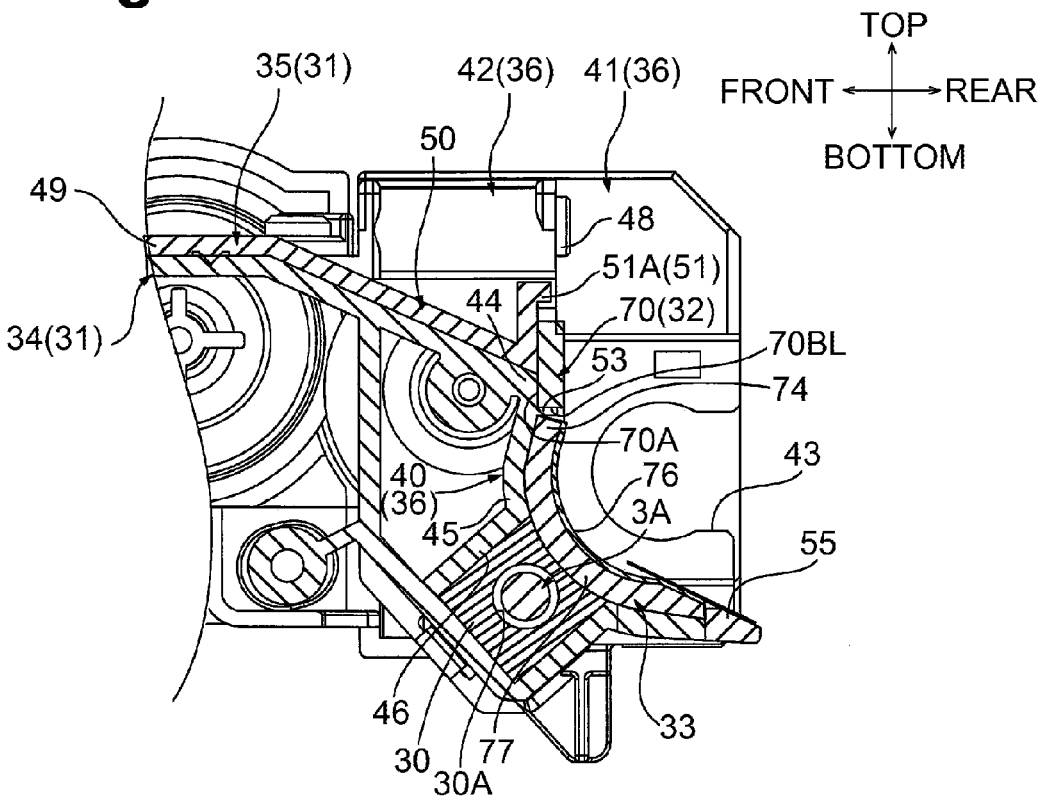
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Fig.9B

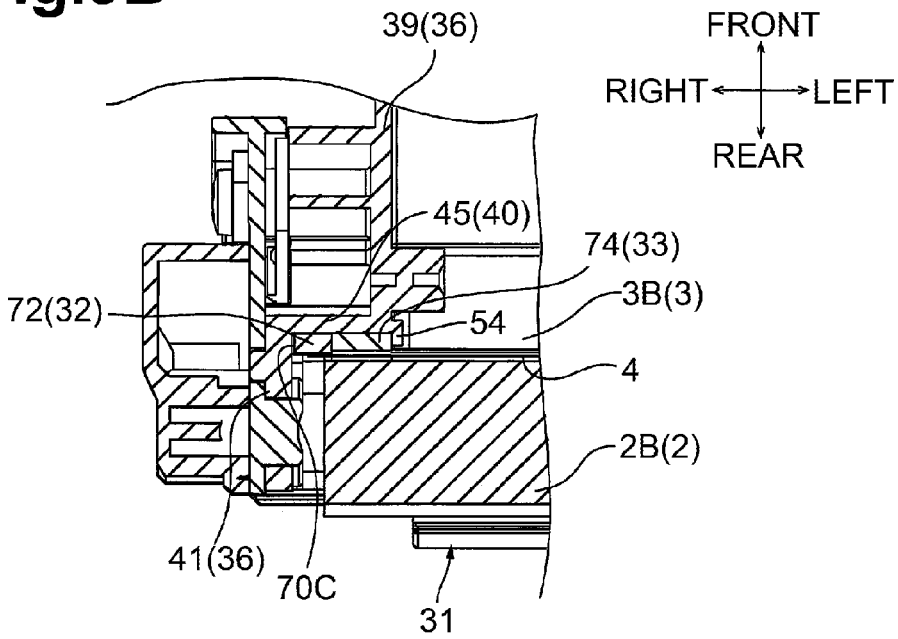
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Fig.10

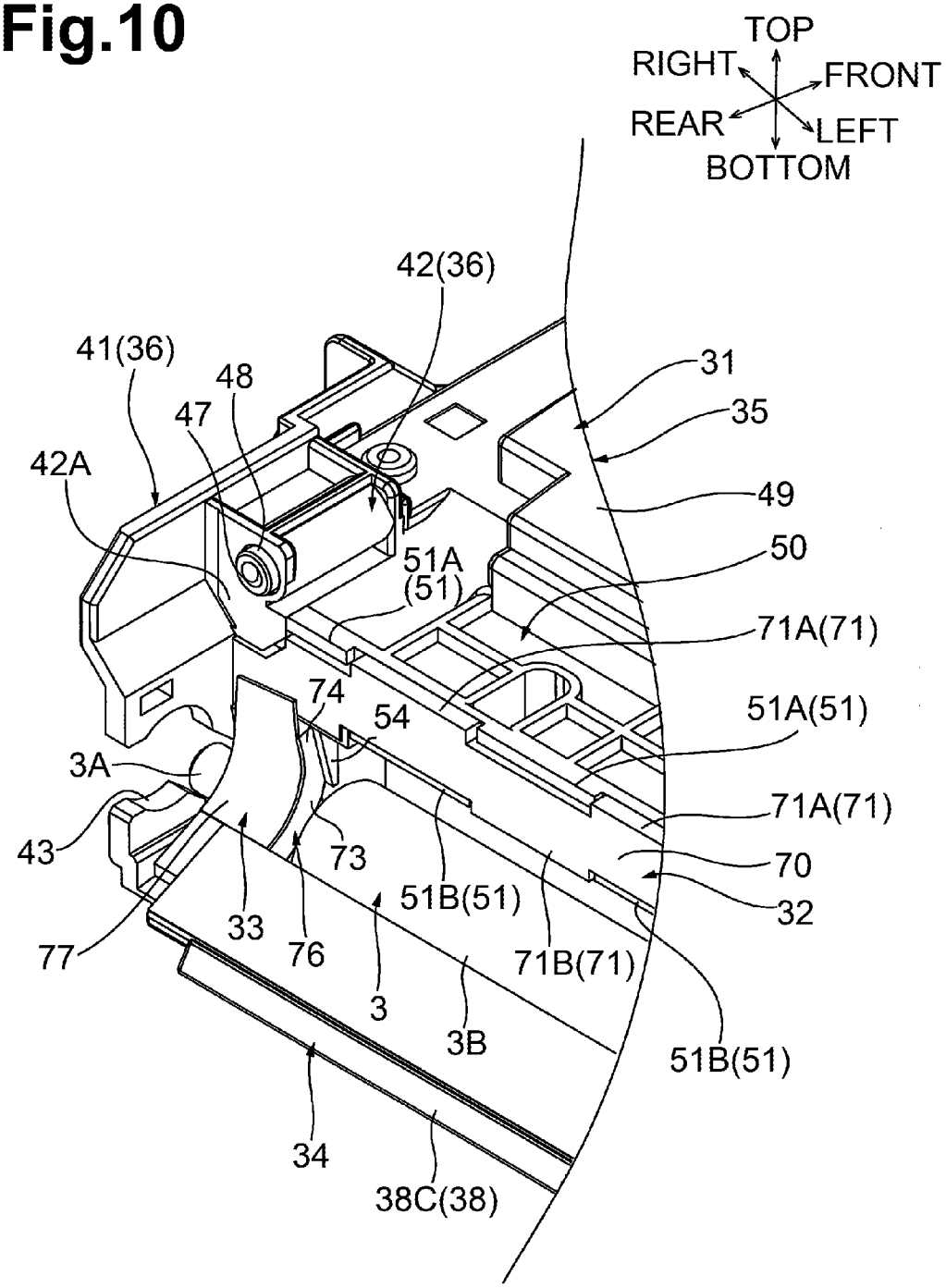
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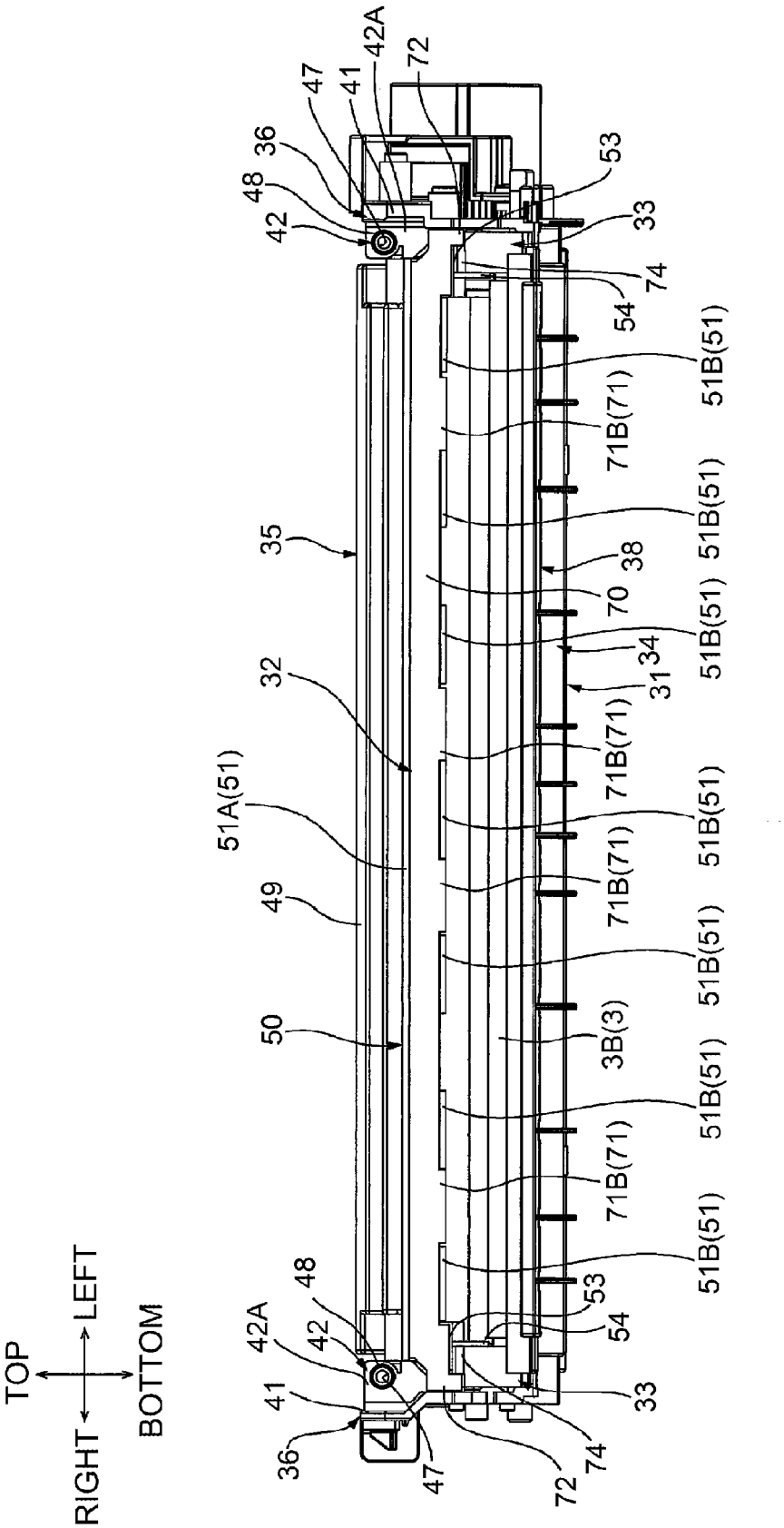
Fig.11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DEVELOPING DEVICE HAVING REGULATING PORTIONS THAT REGULATE MOVEMENT OF A SEAL MEMBER

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority from Japanese Patent Application No. 2013-137423 filed on Jun. 28, 2013, the content of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Technical Field

The disclosure relates to a developing device configured to be mounted or installed in an electrophotographic image forming apparatus.

2. Description of Related Art

A known electrophotographic image forming apparatus includes a photosensitive drum configured to carry an electrostatic latent image and a developing cartridge configured to supply toner to the photosensitive drum.

The developing cartridge includes, for example, a developing case configured to store toner, a developing roller configured to carry the toner, and a layer-thickness regulating blade configured to regulate the thickness of a toner layer on a surface of the developing roller to a constant thickness.

The developing cartridge includes a blade rear seal disposed between the developing case and the layer-thickness regulating blade. The blade rear seal is configured to prevent or reduce the leakage of the toner from a portion between the developing case and the layer-thickness regulating blade.

In the developing cartridge, the blade rear seal includes an elastic layer, e.g., sponge, and a double-sided tape layer. The blade rear seal is attached to the developing case with the double-sided tape layer.

When the blade rear seal is mistakenly attached to a position where it is not intended, it can be difficult to correct the position of the attached blade rear seal. Attachment of the blade rear seal to the developing case may sometimes be difficult or troublesome. The potential for misalignment between the blade rear seal and the developing case increases with the length of the blade rear seal.

SUMMARY

The disclosure relates to a developing device in which a first seal member may be readily attached to a casing of the developing device.

According to one aspect of the disclosure, a developing device may include a casing configured to store a developing agent and a developing agent carrier configured to carry the developing agent in the casing. The developing agent carrier is configured to rotate about an axis extending in a first direction. The developing device further comprises a layer-thickness regulating member configured to regulate a thickness of a layer of the developing agent carried on the developing agent carrier and a first seal member disposed between the layer-thickness regulating blade and the casing. The first seal member extends along the first direction. The casing may include a first regulating portion configured to regulate a movement of the first seal member in the first direction by contacting a surface of the first seal member perpendicular to the first direction. The first regulating portion may include protrusions and/or indentations to regulate the movement of the first seal member. These and other aspects are described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the disclosure, needs satisfied thereby, and the objects, features, and advantages thereof, reference now is made to the following descriptions taken in connection with the accompanying drawing.

FIG. **1** is a side sectional view of a developing cartridge in an illustrative embodiment according to one or more aspects of the disclosure.

FIG. **2** is a side sectional view of an image forming apparatus to which the developing cartridge depicted in FIG. **1** is to be installed.

FIG. **3** is a perspective view of the developing cartridge depicted in FIG. **2** viewed from an upper rear side thereof.

FIG. **4** is an exploded perspective view of the developing cartridge depicted in FIG. **3** viewed from an upper rear side thereof, in which a developing roller and a layer-thickness regulating blade of the developing cartridge are detached, and the developing roller is omitted in FIG. **4**.

FIG. **5** is an exploded perspective view of the developing cartridge depicted in FIG. **4** viewed from an upper rear side thereof, in which a blade seal and a side seal of the developing cartridge are detached and the layer-thickness regulating blade is omitted in FIG. **5**.

FIG. **6** is an exploded perspective view of a developing frame of the developing cartridge depicted in FIG. **5**.

FIG. **7** is a sectional view of the developing cartridge depicted in FIG. **5**.

FIG. **8** is a rear view of the developing cartridge depicted in FIG. **4**.

FIG. **9**A is a sectional view of the developing cartridge taken along the line A-A of FIG. **8**.

FIG. **9**B is a sectional view of the developing cartridge taken along the line B-B of FIG. **8**.

FIG. **10** is a partially perspective view of a developing cartridge according to a modification of the illustrative embodiment.

FIG. **11** is a rear view of a developing cartridge according to another modification of the illustrative embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

An illustrative embodiment is described in detail herein with reference to the accompanying drawings, like reference numerals being used for like corresponding parts in the various drawings.

1. Outline of Developing Cartridge

As depicted in FIG. **1**, a developing device, e.g., a developing cartridge **1**, may comprise a developing agent carrier, e.g., a developing roller **2**, a supply roller **3**, a layer-thickness regulating member, e.g., a layer-thickness regulating blade **4**, and a developing frame **31** comprising a toner chamber **5**.

In the following description, a top-bottom direction, e.g., a vertical direction, of the developing cartridge **1** may be defined in conjunction with an orientation in which the developing cartridge **1** is placed in a horizontal plane. More specifically, the top or upper side and the bottom or lower side in the sheet of FIG. **1** may be defined as the top or upper side and the bottom or lower side of the developing cartridge **1**, respectively. The right side and left side in the sheet of

FIG. **1** may be defined as the front side and rear side of the developing cartridge **1**, respectively. The left-right direction of the developing cartridge **1** may be determined when the developing cartridge **1** is viewed from the front side. More specifically, the front or near side and the back side of the sheet of FIG. **1** may be defined as the left side and the right side of the developing cartridge **1**, respectively. The left-right direction may be an example of a first direction. The front-rear direction may be an example of a second direction. The top-bottom direction may be an example of a third direction.

The developing roller **2** may be rotatably supported in a rear end portion of the developing cartridge **1** to rotate counterclockwise in left side view. The developing roller **2** may comprise a developing roller shaft **2**A and a developing roller body **2**B.

The developing roller shaft **2**A may have a generally cylindrical shape. The developing roller shaft **2**A may extend in the left-right direction. In other words, an axis of the developing roller shaft **2**A may extend in the left-right direction. The developing roller shaft **2**A may comprise metal. Each end portion of the developing roller shaft **2**A in the left-right direction may be inserted into a developing roller shaft insertion opening **43** of the developing frame **31**.

The developing roller body **2**B may have a generally tubular shape. The developing roller body **2**B may extend in the left-right direction. The developing roller body **2**B may comprise rubber having conductivity. The developing roller body **2**B may cover a generally central portion of the developing roller shaft **2**A in the left-right direction, without covering each left and right end portion of the developing roller shaft **2**A.

The supply roller **3** may be disposed at a front lower portion of the developing roller **2**. The supply roller **3** may be supported in the developing cartridge **1** to rotate counterclockwise in left side view. The supply roller **3** may comprise a supply roller shaft **3**A and a supply roller body **3**B.

The supply roller shaft **3**A may have a generally cylindrical shape. The supply roller shaft **3**A may extend in the left-right direction. The supply roller shaft **3**A may comprise metal. Each end portion of the supply roller shaft **3**A in the left-right direction may be inserted into a supply roller shaft insertion opening **30**A of a shaft seal **30** (described below).

The supply roller body **3**B may have a generally tubular shape. The supply roller body **3**B may extend in the left-right direction. The supply roller body **3**B may comprise sponge having conductivity. The supply roller body **3**B may cover a generally central portion of the supply roller shaft **3**A in the left-right direction, without covering each left and right end portion of the supply roller shaft **3**A. The supply roller body **3**B may contact a front lower end of the developing roller body **2**B.

The layer-thickness regulating blade **4** may be disposed at a front upper portion of the developing roller **2**. The layer-thickness regulating blade **4** may contact a front end of the developing roller **2**.

The toner chamber **5** may be disposed in front of the supply roller **3** and the layer-thickness regulating blade **4**. The toner chamber **5** may be configured to store developing agent, e.g., toner. The toner chamber **5** may comprise an agitator **6**.

The agitator **6** may be rotatably supported in the toner chamber **5**.

2. Usage of Developing Cartridge

As depicted in FIG. **2**, the developing cartridge **1** may be used by mounting the developing cartridge **1** to the image forming apparatus **11**.

The image forming apparatus **11** may be an electrophotographic monochrome printer. The image forming apparatus **11** may comprise a main casing **12**, a process cartridge **13**, a scanner unit **14**, and a fixing unit **15**.

The main casing **12** may comprise a front wall, a rear wall, an upper wall, a bottom wall, and side walls. The main casing **12** may have a generally box shape. The main casing **12** may comprise an opening **16**, a front cover **17**, a sheet supply tray **18**, and a sheet discharge tray **19**.

The opening **16** may be disposed at a front end portion of the main casing **12**. The opening **16** may be provided to allow an interior and an exterior of the main casing **12** to communicate with each other in the front-rear direction. The opening **16** may permit the process cartridge **13** to pass therethrough.

The front cover **17** may be disposed at a front end portion of the main casing **12**. The front cover **17** may have a generally flat plate shape. The front cover **17** may extend in the top-bottom direction. The front cover **17** may be pivotally supported about a lower end portion thereof by the front wall of the main casing **12**. The front cover **17** may be configured to open or close the opening **16**.

The sheet supply tray **18** may be disposed at a bottom portion of the main casing **12**. The sheet supply tray **18** may be configured to accommodate one or more sheets P.

The sheet discharge tray **19** may be disposed at a middle portion of the upper wall of the main casing **12** in the front-rear direction. The sheet discharge tray **19** may be depressed downward from an upper surface of the main casing **12** to receive the sheets P.

The process cartridge **13** may be accommodated in a generally central portion of the main casing **12** in the top-bottom direction. The process cartridge **13** may be configured to be attached to or removed from the main casing **12**. The process cartridge **13** may comprise a drum cartridge **20** and the developing cartridge **1**.

The drum cartridge **20** may comprise a photosensitive drum **21**, a scorotron charger **22**, and a transfer roller **23**.

The photosensitive drum **21** may be rotatably supported at a rear end portion of the drum cartridge **20**.

The scorotron charger **22** may be disposed behind the photosensitive drum **21** with a distance between the scorotron charger **22** and the photosensitive drum **21**.

The transfer roller **23** may be disposed below the photosensitive drum **21**. The transfer roller **23** may contact a lower end of the photosensitive drum **21**.

The developing cartridge **1** may be configured to be attached to the drum cartridge **20** in front of the photosensitive drum **21**, such that the developing roller **2** may contact a front lower end of the photosensitive drum **21**.

The scanner unit **14** may be disposed above the process cartridge **13**. The scanner unit **14** may be configured to emit laser beam toward the photosensitive drum **21** based on image data.

The fixing unit **15** may be disposed behind the process cartridge **13**. The fixing unit **15** may comprise a heat roller **24** and a pressure roller **25** that may be pressed against a rear upper end of the heat roller **24**.

When the image forming apparatus **11** starts an image forming operation, the scorotron charger **22** may uniformly change a surface of the photosensitive drum **21**. The scanner unit **14** may expose the surface of the photosensitive drum

21 with light. Thus, an electrostatic latent image based on image data may be formed on the surface of the photosensitive drum **21**.

The agitator **6** may agitate the toner in the toner chamber **5**, and supply the toner to the supply roller **3**. The supply roller **3** may supply the toner supplied by the agitator **6** to the developing roller **2**. At this time, the toner may be positively charged between the developing roller **2** and the supply roller **3** by friction, and be carried on the developing roller **2**. The layer-thickness regulating blade **4** may regulate the thickness of the toner layer carried on the developing roller **2** to a constant thickness.

Then, the toner carried on the developing roller **2** may be supplied to the electrostatic latent image on the surface of the photosensitive drum **21**. Thus, a toner image may be carried on the surface of the photosensitive drum **21**.

The sheets P may be supplied one by one between the photosensitive drum **21** and the transfer roller **23** from the sheet supply tray **18** at a predetermined timing, with the rotation of various rollers. The toner image on the surface of the photosensitive drum **21** may be transferred to the sheet P when the sheet P passes between the photosensitive drum **21** and the transfer roller **23**.

Thereafter, when the sheet P passes between the heat roller **24** and the pressure roller **25**, heat and pressure may be applied to the sheet P. Thus, the toner image on the sheet P may be thermally fixed on the sheet P. Thereafter, the sheet P may be discharged onto the sheet discharge tray **19**.

3. Details of Developing Cartridge

(1) Structure of Developing Cartridge

As depicted in FIGS. **3** and **4**, the developing cartridge **1** may comprise a casing, e.g., the developing frame **31**, the layer-thickness regulating blade **4**, a first seal member, e.g., a blade seal **32**, and a second seal member, e.g., two side seals **33**.

(1-1) Developing Frame

The developing frame **31** may have general a box shape. A rear end portion of the developing frame **31** may be open. The developing frame **31** may comprise a base frame **34** and a cover frame **35**.

As depicted in FIG. **6**, the base frame **34** may have a bottomed frame shape. The base frame **34** may be integrally provided with a pair of side walls **36**, a front wall **37**, and a bottom wall **38**.

Each side wall **36** may be disposed at each end portion of the base frame **34** in the left-right direction. Each side wall **36** may comprise a body **39**, a seal support portion **40**, a first regulating portion and an outward regulating portion (for example, both being represented by a developing roller attachment portion **41**), and a blade attachment portion **42**.

The body **39** may comprise a front half portion of the side walls **36**. The body **39** may have a generally rectangular flat plate shape in side view. The body **39** may extend in the front-rear direction.

The seal support portion **40** may protrude outward in the left-right direction from a rear end portion of the body **39**, and may extend in the top-bottom direction. The seal support portion **40** may comprise a blade seal support portion **44**, a side seal support portion **45**, and a shaft seal support portion **46**.

The blade seal support portion **44** may be disposed at an upper end portion of the seal support portion **40**. The blade seal support portion **44** may have a generally rectangular shape in front view. The blade seal support portion **44** may comprise a first positioning portion **53**.

The first positioning portion **53** may be disposed at a lower end portion of the blade seal support portion **44**. The first positioning portion **53** may protrude rearward from a rear surface of the blade seal support portion **44**, and may extend in the left-right direction. An outward end portion of the first positioning portion **53** in the left-right direction may be positioned inward of the developing roller attachment portion **41** in the left-right direction with a distance from the developing roller attachment portion **41**.

The side seal support portion **45** may be disposed below the blade seal support portion **44**. The side seal support portion **45** may comprise a first support portion **45**A, a curve portion, and a second support portion **45**B. The first support portion **45**A of the side seal support portion **45** may extend downward continuously from a lower end portion of the blade seal support portion **44**. The curve portion of the side seal support portion **45** may continue from the first support portion **45**A. The curve portion may extend downward while curving along a front lower end of the developing roller body **2**B. The curve portion may be open. The second support portion **45**B may continue from the curve portion and extend rearward. The side seal support portion **45** may comprise a second positioning portion **54**, a third positioning portion **55**, and a fourth positioning portion **56**.

The second positioning portion **54** may be disposed inward of the first support portion **45**A and the second support portion **45**B of the side seal support portion **45** in the left-right direction. The second positioning portion **54** may have a generally flat plate shape. The second positioning portion **54** may protrude rearward from inner ends of the first support portion **45**A and the second support portion **45**B in the left-right direction, and may extend in the top-bottom direction. An upper end portion of the second positioning portion **54** may continue to a generally central portion of the first positioning portion **53** in the left-right direction.

The third positioning portion **55** may be disposed at a rear end portion of the side seal support portion **45**. The third positioning portion **55** may protrude upward from a generally central portion of the side seal support portion **45** in the left-right direction. The third positioning portion **55** may have a generally rectangular shape in plan view.

The fourth positioning portion **56** may be disposed outward of the first support portion **45**A and the second support portion **45**B in the left-right direction. The fourth positioning portion **56** may have a generally rectangular flat plate shape in side view. The fourth positioning portion **56** may protrude rearward from outer ends of the first support portion **45**A and the second support portion **45**B in the left-right direction, and may extend in the top-bottom direction. An outer end portion of the fourth positioning portion **56** in the left-right direction may continue to an inner surface of the developing roller attachment portion **41** in the left-right direction.

The shaft seal support portion **46** may be disposed between the first support portion **45**A and the second support portion **45**B in a rotating direction of the developing roller **2**. More specifically, the shaft seal support portion **46** may extend forward and downward from an upstream end of the first support portion **45**A in the rotating direction of the developing roller **2** and a downstream end of the second support portion **45**B in the rotating direction of the developing roller **2**. The shaft seal support portion **46** may have a generally square tubular shape. The shaft seal support portion **46** may open in each end portion thereof in the left-right direction. The shaft seal support portion **46** may be configured to support the shaft seal **30**, as depicted in FIG. **9**A.

The shaft seal **30** may have a generally prism shape. The shaft seal **30** may extend in the left-right direction. The shaft

seal **30** may comprise an elastic member, e.g., sponge. The shaft seal **30** may have a supply roller shaft insertion opening **30**A.

The supply roller shaft insertion opening **30**A may be disposed at a generally central portion of the shaft seal **30** in side view. The supply roller shaft insertion opening **30**A may have a generally circular shape in side view. The supply roller shaft insertion opening **30**A may pass through the shaft seal **30** in the left-right direction. The rear surface of the shaft seal **30** may have a generally in a shape of an arc, in side view, that may extend along the peripheral surface of the developing roller body **2**B. The rear surface of the shaft seal **30** may be generally flush with the rear surface of the side seal support portion **45**.

The developing roller attachment portion **41** may extend rearward from an outer end portion of the seal support portion **40** in the left-right direction, as depicted in FIG. **6**. The developing roller attachment portion **41** may have a generally rectangular flat plate shape in side view. The developing roller attachment portion **41** may have the developing roller shaft insertion opening **43**.

The developing roller shaft insertion opening **43** may be disposed at a rear end portion of the developing roller attachment portion **41**. The developing roller shaft insertion opening **43** may have a generally circular shape in side view with a rear end portion thereof open. The developing roller shaft insertion opening **43** may pass through the developing roller attachment portion **41** in the left-right direction. The inside diameter of the developing roller shaft insertion opening **43** may be greater than the diameter of the developing roller shaft **2**A of the developing roller **2**.

The blade attachment portion **42** may protrude upward continuously from an upper rear end portion of the body **39**. The blade attachment portion **42** may have a generally prism shape. The blade attachment portion **42** may extend in the front-rear direction. A rear surface **42**A of the blade attachment portion **42** may continue to the rear surface of the body **39** and may extend in the top-bottom direction. The blade attachment portion **42** may comprise a screw hole **47** and a boss **48**.

The screw hole **47** may be disposed at an upper end portion of the blade attachment portion **42**. The screw hole **47** may be recessed from the rear surface **42**A of the blade attachment portion **42** toward the front side. The screw hole **47** may have a generally circular shape in front view.

The boss **48** may protrude rearward from the peripheral edge of the screw hole **47**. The boss **48** may have a generally tubular shape.

The bottom wall **38** may be integrally provided with a first portion **38**A, a second portion **38**B, and a third portion **38**C, as depicted in FIGS. **1** and **6**.

The first portion **38**A may be disposed at a front half portion of the base frame **34**. The first portion **38**A may have a generally arc shape in sectional view. A generally central portion of the first portion **38**A in the front-rear direction may be depressed downward. Each left and right end portions of the first portion **38**A may continue to a lower end portion of the body **39** of the relevant side wall **36**. The first portion **38**A may constitute the bottom wall of the toner chamber **5**.

The second portion **38**B may be disposed behind the first portion **38**A. The second portion **38**B may have a generally arc shape in sectional view. The second portion **38**B may continue to a rear end portion of the first portion **38**A and may extend rearward while curving, along an outer peripheral surface of the supply roller **3**. Each left and right end portions of the second portion **38**B may continue to a lower end portion of the shaft seal support portion **46** of the relevant side wall **36**.

The third portion **38**C may be disposed behind the second portion **38**B. The third portion **38**C may have a generally linear shape in sectional view. The third portion **38**C may continue to a rear end portion of the second portion **38**B and may extend rearward. Each left and right end portion of the third portion **38**C may continue to the respective second support portion **45**B of the side walls **36** in the left-right direction.

The front wall **37** may continue to a front end portion of the bottom wall **38** and may extend upward. The front wall **37** may have a generally rectangular shape in front view. Each left and right end portion of the front wall **37** may continue to a front end portion of the body **39** of the relevant side wall **36**.

The cover frame **35** may be disposed above the base frame **34**. The cover frame **35** may be integrally provided with a cover portion **49** and a blade seal support portion **50**.

The cover portion **49** may have a generally rectangular flat plate shape in plan view. A front end portion of the cover portion **49** may be welded to an upper end portion of the front wall **37** of the base frame **34**. Each left and right end portion of the cover portion **49** may be welded to an upper end portion of the relevant side wall **36** of the base frame **34**.

The blade seal support portion **50** may be disposed behind the cover portion **49** between rear end portions of the side walls **36** of the base frame **34**. The blade seal support portion **50** may have a generally rectangular flat plate shape in plan view. The blade seal support portion **50** may continue from a rear end portion of the cover portion **49** and may extend rearward. Each left and right end portion of the blade seal support portion **50** may be welded to the relevant side walls **36** of the base frame **34**. The blade seal support portion **50** may comprise a plurality of second regulating portions, e.g., ribs **51**.

Each rib **51** may be disposed at each end portion of the blade seal support portion **50** in the top-bottom direction, as depicted in FIGS. **6** and **7**. The ribs **51** that may be disposed on an upper end portion of the blade seal support portion **50** may be hereinafter referred to as third regulating portions, e.g., upper ribs **51**A. The ribs **51** that may be disposed on a lower end portion of the blade seal support portion **50** may be hereinafter referred to as fourth regulating portions, e.g., lower ribs **51**B.

The upper ribs **51**A may be disposed in line at upper end portions of the blade seal support portion **50** with a distance between the upper ribs **51**A in the left-right direction. Each upper rib **51**A may protrude rearward from the rear surface of the blade seal support portion **50**, and may extend in the left-right direction. Each upper rib **51**A may have a generally rectangular shape in rear view. A rear edge E**1** of each upper rib **51**A may be disposed in front of the rear surface **42**A of the blade attachment portion **42** when viewed from the left-right direction.

The lower ribs **51**B may be disposed in line at lower end portions of the blade seal support portion **50** with a distance between the lower ribs **51**B in the left-right direction. One of the lower ribs **51**B may be disposed at a generally central portion of the lower end portion of the blade seal support portion **50** in the left-right direction. One of the lower ribs **51**B disposed at the generally central portion of the blade seal support portion **50** in the left-right direction may be an example of a first regulating portion and an inward regulating portion. Each lower rib **51**B may protrude rearward from the rear surface of the blade seal support portion **50**, and may

extend in the left-right direction. Each lower rib **51**B may have a generally rectangular shape in rear view. Each lower rib **51**B may be positioned between a pair of the upper ribs **51**A when viewed in the top-bottom direction. A rear edge E**2** of each lower rib **51**B may be disposed at almost the same position as the rear surface **42**A of the blade attachment portion **42** in the front-rear direction when viewed from the left-right direction. A protruding amount L**2** of each lower rib **51**B may be greater than a protruding amount L**1** of each upper rib **51**A.

(1-2) Blade Seal and Side Seals

As depicted in FIGS. **8**-**9**B, a portion of the blade seal **32** may be disposed between the rear surface of the blade seal support portion **50** of the cover frame **35** and the layer-thickness regulating blade **4**. Other portion of the blade seal **32** may be disposed between the rear surface of the blade seal support portion **44** of the base frame **34** and the layer-thickness regulating blade **4**. The portion of the front surface of the blade seal **32** may directly contact the rear surface of the blade seal support portion **50** of the cover frame **35**, without an adhesive layer. The other portion of the front surface of the blade seal **32** may directly contact the rear surface of the blade seal support portion **44** of the base frame **34**, without an adhesive layer. The rear surface of the blade seal **32** may directly contact the front surface of the layer-thickness regulating blade **4**, without an adhesive layer. The blade seal **32** may comprise a resin sponge. The blade seal **32** may extend in the left-right direction and may have a generally prism shape. The blade seal **32** may be symmetrical with respect to an imaginary plane L passing through the center of the blade seal **32** in the left-right direction and extending in the top-bottom direction. The blade seal **32** may comprise a blade seal body **70**, a plurality of extensions, e.g., protrusions **71**, and a first protrusion, e.g., two engagement portions **72**.

The blade seal body **70** may be disposed between the upper ribs **51**A and the lower ribs **51**B. In other words, an upper surface **70**D of the blade seal body **70** may contact a lower surface **51**AL of each upper rib **51**A. A lower surface **70**E of the blade seal body **70** may contact an upper surface **51**BU of each lower rib **51**B. The blade seal body **70** may have a generally prism shape. The blade seal body **70** may extend in the left-right direction. A front surface **70**A of each left and right end portion of the blade seal body **70** may contact the rear surface of the blade seal support portion **44** of the base frame **34**, as depicted in FIG. **9**A. Each left and right end portion **70**B of the blade seal body **70** may contact the upper surface of the first positioning portion **53** of the relevant side wall **36**, as depicted in FIGS. **8** and **9**A. More specifically, each left and right end portion **70**B of the blade seal body **70** may have a lower surface **70**BL substantially perpendicular to the top-bottom direction. The lower surface **70**BL may contact the upper surface of the first positioning portion **53**. Each left and right end face **70**C of the blade seal body **70** may contact the inner surface of the developing roller attachment portion **41** of the relevant side wall **36** in the left-right direction, as depicted in FIGS. **8** and **9**B. Each left and right end face **70**C of the blade seal body **70** may be substantially perpendicular to the left-right direction.

As depicted in FIGS. **5** and **8**, each protrusion **71** may be disposed at each upper and lower end portion of the blade seal **32**. The protrusions **71** that may be disposed at an upper end portion of the blade seal **32** may be hereinafter referred to as the upper protrusions **71**A. The protrusions **71** may be disposed at a lower end portion of the blade seal **32** may be hereinafter referred to as the lower protrusions **71**B.

The upper protrusions **71**A may be disposed in line at an upper end portion of the blade seal **32** with a distance between the upper protrusions **71**A in the left-right direction. Each upper protrusion **71**A may protrude upward from an upper surface of the blade seal body **70** and may extend in the left-right direction. Each upper protrusion **71**A may have a generally rectangular shape in rear view. Each upper protrusion **71**A may be disposed between a pair of the upper ribs **51**A. Each upper protrusion **71**A may be slightly spaced apart from the upper ribs **51**A disposed next to the upper protrusion **71**A in the left-right direction when the blade seal **32** is set to the developing frame **31**.

Each lower protrusion **71**B may be disposed in line at a lower end portion of the blade seal **32** with a distance between the lower protrusions **71**B in the left-right direction. More specifically, two lower protrusions **71**B may be disposed at a generally central portion of the blade seal **32** in the left-right direction with a distance therebetween and one lower protrusion **71**B may be disposed at each end portion of the blade seal **32** in the left-right direction. Each lower protrusion **71**B may protrude downward from a lower surface of the blade seal body **70**, and may extend in the left-right direction. Each lower protrusion **71**B may have a generally rectangular shape in rear view. Each of the two lower protrusions **71**B provided at a generally central portion of the blade seal **32** in the left-right direction may be disposed at each right and left side of the lower rib **51**B provided at a generally central portion of the blade seal support portion **50** in the left-right direction. Each of the two lower protrusions **71**B disposed at a generally central portion of the blade seal **32** in the left-right direction may contact respective end face of the lower rib **51**B disposed at a generally central portion of the blade seal support portion **50** in the left-right direction. The interaction between an end of lower protrusion **71**B and the end of rib **51**B minimizes movement of blade seal **32**. In one example, each end face **71**BS of each lower protrusion **71**B substantially perpendicular to the left-right direction may contact relevant end face **51**BS of the lower rib **51**B in the left-right direction. Each leftmost and rightmost lower protrusion **71**B may be disposed between the corresponding two lower ribs **51**B. It is appreciated that "substantially perpendicular" includes perpendicular orientations as well as orientations of the end faces other than perpendicular (e.g., acute or obtuse) with respect to the left-right direction. This non-parallel orientation of end face **71**BS and/or end face **51**BS with respect to the left-right direction may also minimize movement and are considered within the scope of this disclosure. In other words, movement may be minimized when each of end face **71**BS and end face **51**BS are not parallel with the left-right direction (though not necessarily parallel with each other). In another example, ends of the lower protrusion **71**B may be shapes other than planar surfaces (i.e., other than planar surfaces **71**BS).

Each engagement portion **72** may be disposed at each end portion of the blade seal **32** in the left-right direction outward of the leftmost and rightmost lower protrusion **71**B in the left-right direction. Each engagement portion **72** may protrude downward from a lower surface of the blade seal body **70** such that each engagement portion **72** may be placed below the respective first positioning portion **53**. Each engagement portion **72** may have a generally rectangular shape in rear view. Each engagement portion **72** may be disposed between the developing roller attachment portion **41** and the first positioning portion **53**. A lower surface **72**A of each engagement portion **72** may contact an upper surface **33**A of the relevant side seal **33** at positions outward

of a first engagement portion **74** (described below) in the left-right direction. The lower surfaces **72**A of the engagement portions **72** of the blade seal **32** may be an example of a plurality of faces.

Each of the two side seals **33** may be disposed below each left and right end portion of the blade seal **32** between the side seal support portion **45** of each side wall **36** and each left and right end portion of the developing roller body **2**. Each side seals **33** may directly contact the side seal support portion **45** of each the side wall **36** without an adhesive layer. Each side seal **33** may comprise a base layer **76** and a seal layer **77**.

The base layer **76** may comprise sponge comprising resin, e.g., urethane resin, or elastomer, e.g., silicon rubber and natural rubber. The base layer **76** may be more flexible than the blade seal **32**. The base layer **76** may comprise a base layer body **73**, a second protrusion, e.g., a first engagement portion **74**, and a second engagement portion **75**.

The base layer body **73** may have a generally rectangular flat plate shape in rear view. The base layer body **73** may extend in the top-bottom direction, while curving, along the curvature of the side seal support portion **45**. The dimension of the base layer body **73** in the left-right direction may be approximately the same as the dimension of the side seal support portion **45** in the left-right direction. A lower end portion of the base layer body **73** may contact a front end portion of the third positioning portion **55**. An upper outer end portion of the base layer body **73** in the left-right direction may contact an inner surface of the fourth positioning portion **56** in the left-right direction.

The first engagement portion **74** may be disposed at an upper end portion of the base layer **76**. The first engagement portion **74** may be positioned inward of the engagement portion **72** of the blade seal **32** in the left-right direction. The first engagement portion **74** may extend upward continuously from an upper inner end portion of the base layer body **73** in the left-right direction. The first engagement portion **74** may have a generally prism shape. An upper end portion of the first engagement portion **74** may contact the lower surface of the first positioning portion **53** of the side walls **36**. An inner end portion of the first engagement portion **74** in the left-right direction may contact the outer surface of the second positioning portion **54** of the side walls **36** in the left-right direction. An outer surface **74**A of the first engagement portion **74** in the left-right direction may contact an inner surface **72**B of the engagement portion **72** of the blade seal **32** in the left-right direction. The inner surface **72**B of the engagement portion **72** of the blade seal **32** in the left-right direction may be an example of a plurality of faces.

The second engagement portion **75** may be disposed at a lower end portion of the base layer **76**. The second engagement portion **75** may extend downward continuously from a lower inner end portion of the base layer body **73** in the left-right direction. The second engagement portion **75** may have a generally prism shape. An outer end portion of the second engagement portion **75** in the left-right direction may face the inner surface of the third positioning portion **55** of the side walls **36** in the left-right direction.

The seal layer **77** may be adhered to the front surface of the base layer body **73**. The seal layer **77** may have a shape similar to that of the base layer body **73**. The seal layer **77** may comprise nonwoven fabric, or woven fabric, e.g., cashmere fiber, polytetrafluoroethylene fiber, and polyester fiber. The rear surface of the seal layer **77** may contact the peripheral surface of each left-right end portion of the developing roller body **2**B.

(1-3) Layer-Thickness Regulating Blade

As depicted in FIGS. **1** and **4**, the layer-thickness regulating blade **4** may comprise a first holding member **62**, a second holding member **63**, and a blade member **61**.

The first holding member **62** may be disposed above the blade seal support portion **50** of the cover frame **35**. The first holding member **62** may be elongated in the left-right direction. The first holding member **62** may have a generally L-shaped bent plate shape in sectional view. More specifically, a front portion of the first holding member **62** may extend in the front-rear direction. A rear portion of the first holding member **62** may bend downward at a rear end portion of the front portion of the first holding member **62**. A front end portion of the first holding member **62** may face an upper end portion of the blade seal support portion **50**. The first holding member **62** may comprise two fixing portions **64**.

Each fixing portion **64** may protrude upward from each left and right end of the first holding member **62**. Each fixing portion **64** may have a generally rectangular flat plate shape in front view. Each fixing portion **64** may have a through hole (not depicted) into which the boss **48** of the base frame **34** may fit. Each fixing portion **64** may contact the respective rear surface **42**A of each blade attachment portion **42**. Each fixing portion **64** may be fixed to the respective rear surface **42**A of each blade attachment portion **42** of the base frame **34** with a screw **66** screwed into the screw hole **47** of the base frame **34**.

The second holding member **63** may be disposed above the first holding member **62**. The second holding member **63** may be elongated in the left-right direction. The second holding member **63** may have a generally L-shaped bent plate shape in sectional view. More specifically, a front portion of the second holding member **63** may extend in the front-rear direction above the first holding member **62**. A rear portion of the second holding member **63** may bend downward at a rear end portion of the front portion of the second holding member **63**, to face an upper end portion of the blade member **61** behind the blade member **61**. The second holding member **63** may be fixed to the first holding member **62** with screws **65**.

The blade member **61** may have a generally rectangular flat plate shape elongated in the left-right direction in front view. The blade member **61** may extend in the top-bottom direction. An upper end portion of the blade member **61** may be interposed between the rear portion of the first holding member **62** and the rear portion of the second holding member **63**. A lower end portion of the blade member **61** may contact a front end portion of the developing roller **2**.

(2) Attachment of Layer-Thickness Regulating Blade

An operator or worker may attach the layer-thickness regulating blade **4** to the developing frame **31** during the assembly of the developing cartridge **1**, as depicted in FIGS. **4** and **5**, in which the supply roller **3** may be already mounted to the developing frame **31**.

First, the operator may attach the side seals **33** to the ride seal support portions **45** of the developing frame **31**.

An upper end portion of the side seal **33** may contact the first positioning portion **53** of the side walls **36**. A lower end portion of the side seal **33** may contact the third positioning portion **55** of the side wall **36**. Thus, the movement of the side seal **33** between the first positioning portion **53** and the third positioning portion **55** in a rotation direction of the developing roller **2**, e.g., a counterclockwise direction in left side view, may be restricted. The first engagement portion **74** of the side seal **33** may contact the second positioning portion **54** of the side wall **36** at an inner end portion thereof in the left-right direction.

Thereafter, the operator may attach the blade seal **32** to the blade seal support portion **50** of the cover frame **35** and the blade seal support portions **44** of the base frame **34**.

At this time, the blade seal **32** may contact the rear surface of the blade seal support portion **50** of the cover frame **35** and the rear surface of the blade seal support portions **44** of the base frame **34** without an adhesive layer.

Therefore, the operator may adjust the position of the blade seal **32** relative to the blade seal support portion **50** while pressing the blade seal **32** against the blade seal support portion **50**.

The blade seal **32** may be assembled to the blade seal support portion **50** of the cover frame **35** between the upper ribs **51**A and the lower ribs **51**B. The engagement portion **72** of the blade seal **32** may be disposed between the first engagement portion **74** of the side seal **33** and the developing roller attachment portion **41**, in a compressed state. In other words, when the engagement portion **72** is not in the compressed state, a distance between the developing roller attachment portion **41** and the second positioning portion **54** in the left-right direction may be shorter than the sum of the length of the first engagement portion **74** of the side seal **33** in the left-right direction and the length of the engagement portion **72** of the blade seal **32** in the left-right direction.

The dimension of the blade seal **32** in the front-rear direction may be slightly longer than the protruding amount L**2** of the lower ribs **51**B, before the blade seal **32** is attached to the developing frame **31**, as depicted in FIG. **7**. More specifically, the protruding amount L**2** of the lower ribs **51**B may be appropriately a half (½) of the dimension of the blade seal **32** in the front-rear direction.

Thereafter, the operator may screw the layer-thickness regulating blade **4** to the blade attachment portions **42** of the developing frame **31**.

As depicted in FIG. **1**, an upper half portion of the blade seal **32** may be slightly compressed in the front-rear direction between the rear surface of the blade seal support portion **50** of the cover frame **35** and the first holding member **62** of the layer-thickness regulating blade **4** and between the rear surfaces of the blade seal support portions **44** of the base frame **34** and the first holding member **62** of the layer-thickness regulating blade **4**.

At this time, the dimension of the upper half portion of the blade seal **32** in the front-rear direction may be almost the same as the protruding amount L**2** of the lower ribs **51**B.

A lower half portion of the blade seal **32** may deform to expand rearward as the upper half portion of the blade seal **32** is compressed. Therefore, the lower half portion of the blade seal **32** may be pressed against the front face of the blade member **61** of the layer-thickness regulating blade **4**. Thus, the lower half portion of the blade seal **32** may make close contact with the blade member **61** of the layer-thickness regulating blade **4**.

Thus, attachment of the layer-thickness regulating blade **4** to the developing frame **31** may complete.

4. Effects

(1) In the developing cartridge **1**, the position of the blade seal **32** may be fixed relative to the developing frame **31** in the left-right direction as the left and right ends of one of the lower ribs **51**B provided at a generally central portion of the blade seal support portion **50** in the left-right direction may contact each of the two lower protrusions **71**B disposed at a generally central portion of the blade seal **32**, and each left and right end portion of the blade seal **32** may contact the respective the developing roller attachment portion **41** of the side wall **36**, as depicted in FIG. **8**.

Therefore, the blade seal **32** may be attached to the developing frame **31** without a member configured to fix the blade seal **32** to the developing frame **31**.

Consequently, the blade seal **32** may be readily attached to the developing frame **31**.

(2) In the developing cartridge **1**, as depicted in FIG. **1**, the blade seal **32** may directly contact the blade seal support portions **44** of the base frame **34**, the blade seal support portion **50** of the cover frame **35** and the layer-thickness regulating blade **4** without adhesive material.

Therefore, the position of the blade seal **32** may be adjusted with the blade seal **32** contacting the blade seal support portion **44** and the blade seal support portion **50**.

Consequently, the blade seal **32** may be attached to the developing frame **31** more readily.

(3) In the developing cartridge **1**, the movement of a generally central portion of the blade seal **32** in the left-right direction may be restricted, as the left and right ends of one of the lower ribs **51**B provided at a generally central portion of the blade seal support portion **50** in the left-right direction may contact each of the two lower protrusions **71**B disposed at a generally central portion of the blade seal **32**, as depicted in FIG. **8**.

Therefore, a generally central portion of the blade seal **32** in the left-right direction may be reliably disposed between the blade seal support portion **50** of the cover frame **35** and the layer-thickness regulating blade **4**.

(4) In the developing cartridge **1**, the movement of the blade seal **32** in the top-bottom direction may be restricted by the upper ribs **51**A and the lower ribs **51**B, as depicted in FIG. **8**.

Therefore, the position of the blade seal **32** may be fixed relative to the developing frame **31** more reliably.

(5) In the developing cartridge **1**, the upper ribs **51**A and the lower ribs **51**B may interpose the blade seal **32** therebetween at each side of the blade seal **32** in the top-bottom direction, as depicted in FIG. **8**.

Therefore, the movement of the blade seal **32** in the top-bottom direction may be restricted by the upper ribs **51**A and the lower ribs **51**B.

Consequently, the position of the blade seal **32** may be fixed relative to the developing frame **31** more reliably.

(6) In the developing cartridge **1**, each protrusion **71** of the blade seal **32** may be disposed between the upper ribs **51**A and between the lower ribs **51**B, as depicted in FIG. **8**. Thus, the blade seal **32** may be supported by the developing frame **31** more stably.

(7) In the developing cartridge **1**, each upper rib **51**A may be positioned between the lower ribs **51**B when viewed from the top-bottom direction, as depicted in FIG. **8**.

Therefore, the protrusions **71** of the blade seal **32** may be arranged alternately at upper portions and lower portions of the blade seal **32**.

Thus, the length of the blade seal body **70** in the top-bottom direction may be constant across the blade seal body **70** in its left-right direction.

Consequently, the sealability or effectiveness of seal of the blade seal body **70** may be constant in its top-bottom direction.

(8) In the developing cartridge **1**, as depicted in FIG. **8**, the lower rib **51**B provided at a generally central portion of the blade seal support portion **50** in the left-right direction may contact the two lower protrusions **71**B at a generally central portion of the blade seal **32** in the left-right direction. Each upper rib **51**A may be disposed between the upper protrusions **71**A, to provide a space therebetween in the left-right

direction or to separate from the respective upper protrusions **71**A in the left-right direction.

Therefore, the movement of the blade seal **32** in the left-right direction may be restricted at the lower rib **51**B provided at a generally central portion of the blade seal support portion **50**. Further, dimensional errors of the blade seal **32** may be absorbed in the upper ribs **51**A.

Consequently, ease of attachment of the blade seal **32** to the developing frame **31** may be improved while accuracy of positioning the blade seal **32** relative to the developing frame **31** is ensured.

(9) In the developing cartridge **1**, the protruding amount L**2** of the lower rib **51**B may be greater than or equal to the protruding amount L**1** of the upper rib **51**A, as depicted in FIG. **7**.

Therefore, when the blade seal **32** is attached to the developing frame **31**, the blade seal **32** may be prevented from coming off or slipping off downward.

Consequently, the blade seal **32** may be readily attached to the developing frame **31**.

(10) In the developing cartridge **1**, as depicted in FIG. **7**, the protruding amount L**2** of the lower rib **51**B may be approximately a half of the dimension of the blade seal **32** in the front-rear direction.

Therefore, when the blade seal **32** is attached to the developing frame **31**, the blade seal **32** may further be prevented or reduced from coming off or slipping off downward.

(11) In the developing cartridge **1**, as depicted in FIG. **7**, the rear edge E**1** of each upper rib **51**A may be positioned in front of the rear surface **42**A of the blade attachment portion **42**.

Therefore, the layer-thickness regulating blade **4** supported by the blade attachment portion **42** may be prevented or reduced from interfering with the ribs **51**.

(12) In the developing cartridge **1**, the movement of each left and right end portion of the blade seal **32** may be restricted by the contact between each end portion of the blade seal **32** in the left-right direction and the respective developing roller attachment portion **41** of each side wall **36**, as depicted in FIG. **8**.

Therefore, each left and right end portion of the blade seal **32** may be reliably positioned between the blade seal support portion **44** of the base frame **34** and the layer-thickness regulating blade **4**.

(13) In the developing cartridge **1**, each end portion of the blade seal body **70** in the left-right direction may contact the upper surface of the respective first positioning portion **53** of each side wall **36**, as depicted in FIG. **8**. An upper end portion of the first engagement portion **74** of each side seal **33** may contact the lower surface of the respective first positioning portion **53** of each side wall **36**.

Therefore, the blade seal **32** and the side seals **33** may be positioned relative to the first positioning portions **53**.

Consequently, the arrangement of the blade seal **32** relative to the side seal **33** may be ensured.

(14) In the developing cartridge **1**, the side seal **33** may directly contact the side seal support portion **45**, without an adhesive material.

Therefore, the side seal **33** may be readily attached to the side seal support portion **45**.

(15) In the developing cartridge **1**, the developing roller attachment portion **41** and the second positioning portion **54** may interpose the engagement portion **72** of the blade seal **32** and the first engagement portion **74** of the side seal **33** therebetween, as depicted in FIG. **8**.

Therefore, the engagement portion **72** of the blade seal **32** and the first engagement portion **74** of the side seal **33** may be make reliable contact with each other. Thus, the sealability or effectiveness of seal between the engagement portion **72** of the blade seal **32** and the first engagement portion **74** of the side seal **33** may be ensured.

(16) In the developing cartridge **1**, distance between the developing roller attachment portion **41** and the second positioning portion **54** may be shorter than the sum of the length of the engagement portion **72** of the blade seal **32** in the left-right direction and the length of the first engagement portion **74** of the side seal **33** in the left-right direction.

Therefore, the engagement portion **72** of the blade seal **32** and the first engagement portion **74** of the side seal **33** may be compressed between the developing roller attachment portion **41** and the second positioning portion **54**, as depicted in FIG. **8**.

Consequently, the sealability or effectiveness of seal between the blade seal **32** and the side seal **33** may further be ensured.

(17) In the developing cartridge **1**, the blade seal **32** may be more flexible than the side seal **33**.

Therefore, the engagement portion **72** of the blade seal **32** may be compressed between the developing roller attachment portion **41** and the first engagement portion **74** of the side seal **33**, as depicted in FIG. **8**.

Consequently, the sealability or effectiveness of seal between the blade seal **32** and the side seal **33** may further be ensured while twist of the side seal **33** may be prevented or reduced.

(18) In the developing cartridge **1**, the first engagement portion **74** of the side seal **33** may contact the second positioning portion **54**, as depicted in FIG. **8**.

Therefore, the first engagement portion **74** of the side seal **33** may be positioned in the left-right direction more reliably.

(19) In the developing cartridge **1**, the engagement portion **72** of the blade seal **32** may contact the side seal **33** at a lower end portion and an inner end portion of the engagement portion **72** in the left-right direction, as depicted in FIG. **8**.

Therefore, the sealability or effectiveness of seal between the blade seal **32** and the side seal **33** may further be ensured.

(20) In the developing cartridge **1**, the blade seal **32** may be symmetrical with respect to an imaginary plane L passing through the center of the blade seal **32** in the left-right direction and extending in the top-bottom direction, as depicted in FIG. **8**.

Therefore, the blade seal **32** may be attached to the developing frame **31**, even when the blade seal **32** may be flipped horizontally.

Consequently, the blade seal **32** may be attached to the developing frame **31** more readily.

5. Modifications

(1) As depicted in FIG. **10**, the seal layer **77** of the side seal **33** may be configured to extend above an upper end portion of the base layer **76**. The extended portion of the seal layer **77** may be disposed over the first positioning portion **53** of the side wall **36** and the rear surface of each left and right end portion of the blade seal **32**.

In the modification, the seal layer **77** may cover the boundary between the side seal **33** and the blade seal **32**.

Therefore, entry of the toner into the boundary between the side seal **33** and the blade seal **32** may be prevented or reduced.

A contact portion between the blade seal **32** and the first positioning portion **53** and a contact portion between the

side seal **33** and the first positioning portion **53** may be covered with the seal layer **77**.

(2) As depicted in FIG. **11**, the upper ribs **51**A may be configured to continuously extend in the left-right direction. Thus, the upper rib **51**A may be simply structured. The blade seal **32** may be attached to the blade seal support portions **44** and the blade seal support portion **50** more readily.

(3) In the above-described illustrative embodiment, the blade seal **32** may be structured not to have, for example, the upper protrusions **71**A.

(4) In the above-described illustrative embodiment, a magnetic roller may be used in place of the developing roller **2**.

(5) In the above-described illustrative embodiment, the process cartridge **13** may be structured to integrally provide a developing unit comprising the developing roller **2** and a drum unit comprising the photosensitive drum **21**.

(6) In the above-described illustrative embodiment, the blade seal **32** may be structured such that each surface of at least one of the lower protrusions **71**B in the left-right direction may be disposed between the lower ribs **51**B of the blade seal support portion **50**.

(7) In the above-described illustrative embodiment, each left and right end portion of the blade seal **32** may contact an inner surface of the respective developing roller attachment portion **41** in the left-right direction. A structure to position the blade seal **32** in the left-right direction might not be particularly limited. For example, each of the left and right blade seal support portions **44** may comprise a rib that may protrude rearward from the rear surface thereof. The rib may be configured to contact each left and right end portion of the blade seal **32**.

While the disclosure has been described in detail with reference to the specific embodiment thereof, this is merely an example, and various changes, arrangements and modifications may be applied therein without departing from the spirit and scope of the disclosure.

What is claimed is:

1. A developing device comprising:

a casing configured to store a developing agent;

a developing agent carrier configured to carry the developing agent in the casing, the developing agent carrier configured to rotate about an axis extending in a first direction;

a layer-thickness regulating member configured to regulate a thickness of a layer of the developing agent carried on the developing agent carrier; and

a first seal member disposed between the layer-thickness regulating member and the casing and is disposed to oppose the layer-thickness regulating member in a second direction perpendicular to the first direction, the first seal member extending along the first direction and including a first end and a second end and including an upper side and lower side,

wherein the casing includes a first regulating portion configured to regulate a movement of the first seal member in the first direction by contacting the first end of the first seal member that is non-parallel with respect to the first direction and the casing including a second regulating portion configured to regulate a movement of the first seal member in the first direction by contacting the second end of the first seal member that is non-parallel with respect to the first direction,

wherein the casing includes a plurality of third regulating portions spaced from each other configured to regulate a movement of the first seal member in a third direction perpendicular to the second direction and the first direction, and

wherein the third regulating portions contact the upper side of the first seal member,

wherein the plurality of third regulating portions are formed with upper ribs spaced from each other in the first direction, and

wherein the first seal member includes a plurality of upper protrusions protruding in the third direction and each of the upper protrusions is disposed between a pair of the upper ribs.

2. The developing device according to claim **1**,

wherein the first seal member directly contacts the casing and the layer-thickness regulating member without an adhesive material.

3. The developing device according to claim **1**,

wherein each of the third regulating portions include an inward regulating portion disposed inward of each end portion of the first seal member in the first direction.

4. The developing device according to claim **1**,

wherein the casing includes a plurality of fourth regulating portions spaced from each other and configured to regulate a movement of the first seal member in the third direction perpendicular to the second direction and the first direction, and

wherein the fourth regulating portions contact the lower side of the first seal member,

wherein the plurality of fourth regulating portions that contact the lower side of the first seal member are formed with lower ribs spaced from each other in the first direction, and

wherein the first seal member includes a plurality of lower protrusions protruding in the third direction and each of the lower protrusions is disposed between a pair of the lower ribs.

5. The developing device according to claim **4**,

wherein the first seal member includes an extension extending toward one side of the third direction or an opposite side of the third direction such that the extension is disposed between the third regulating portions or between the fourth regulating portions.

6. The developing device according to claim **5**,

wherein one of a group of the fourth regulating portions and a group of the third regulating portions contacts a respective group of the four protrusions or third protrusions in the first direction, and

wherein the other one of the group of the fourth regulating portions and the group of the third regulating portions is separated from the respective group of fourth protrusions or third protrusions in the first direction.

7. The developing device according to claim **4**,

wherein each of the third regulating portions is disposed between a pair of the fourth regulating portions when viewed from the third direction.

8. The developing device according to claim **4**,

wherein at least one of the third regulating portion and the fourth regulating portion continuously extends in the first direction.

9. The developing device according to claim **4**,

wherein the casing includes a first support portion supporting the first seal member,

wherein the third regulating portion and the fourth regulating portion protrude from the first support portion in the second direction, and

wherein a protruding amount of the fourth regulating portion is greater than or equal to a protruding amount of the third regulating portion.

10. The developing device according to claim **4**,

wherein the casing includes a first support portion supporting the first seal member,

wherein the fourth regulating portion protrudes from the first support portion in the second direction, and

wherein a protruding amount of the fourth regulating portion is greater than a half of a length of the first seal member in the second direction and shorter than the length of the first seal member in the second direction.

11. The developing device according to claim **1**,

wherein the casing includes a support portion supporting the layer-thickness regulating member and protruding from each end portion of the casing in the first direction toward an opposite side of the second direction to one side of the second direction,

wherein the second regulating portion protrudes from the one side of the second direction to the opposite side of the second direction, and

wherein an end portion of the second regulating portion on the opposite side of the second direction is disposed closer to the one side of the second direction than an end portion of the support portion on the opposite side of the second direction.

12. The developing device according to claim **1**,

wherein the first seal member includes end portions, and

wherein each of the first regulating portion and the second regulating portion includes an outward regulating portion disposed outward of each end portion of the first seal member in the first direction.

13. The developing device according to claim **12**,

further comprising a second seal member disposed between an end portion of the developing agent carrier in the first direction and the casing,

wherein the first seal member and the second seal member are disposed adjacent to each other in a rotation direction of the developing agent carrier,

wherein the casing includes a first positioning portion protruding in a second direction perpendicular to the first direction, and the first positioning portion is configured to regulate a movement of the second seal member in the rotation direction by contacting a downstream end portion of the second seal member in the rotation direction, and

wherein the first positioning portion contacts the first seal member in the rotation direction.

14. The developing device according to claim **13**,

wherein the second seal member directly contacts the casing without an adhesive material.

15. The developing device according to claim **13**,

wherein an end portion of the first seal member in the first direction includes a first protrusion protruding toward the second seal member,

wherein the second seal member includes a second protrusion protruding toward the first seal member,

wherein the first protrusion and the second protrusion overlap with each other when projected in the first direction,

wherein the casing includes a second positioning portion disposed inward of the outward regulating portion in the first direction with a distance therebetween, the second positioning portion positions the second seal member relative to the first direction, and

wherein the first protrusion and the second protrusion are disposed between the outward regulating portion and the second positioning portion when projected in the first direction.

16. The developing device according to claim **15**,

wherein a distance between the outward regulating portion and the second positioning portion is shorter than a sum of a length of the first protrusion in the first direction and a length of the second protrusion in in the first direction.

17. The developing device according to claim **15**,

wherein the first seal member is more flexible than the second seal member, and

wherein the first protrusion contacts the outward regulating portion.

18. The developing device according to claim **17**,

wherein the second protrusion contacts the second positioning portion.

19. The developing device according to claim **15**,

wherein the first seal member contacts the second seal member at a plurality of faces thereof.

20. The developing device according to claim **13**,

wherein the second seal member includes a base layer and a seal layer laminated on the base layer, and

wherein the seal layer overlaps with the first seal member.

21. The developing device according to claim **20**,

wherein the seal layer overlaps with the first positioning portion.

22. The developing device according to claim **1**,

wherein the first seal member is symmetrical with respect to an imaginary plane passing through a center of the first seal member in the first direction and extending in a third direction perpendicular to the first direction.

23. The developing device according to claim **1**,

wherein the first regulating portion contacts a surface of the first seal member perpendicular to the first direction.

24. The developing device according to claim **1**,

wherein the first regulating portion is a surface extending in the first direction.

25. A developing device comprising:

a casing configured to store a developing agent, the casing including a first attachment portion and a second attachment portion, an inward-facing surface of the first attachment portion being separated from an inward-facing surface of the second attachment portion by a distance;

a developing agent carrier configured to carry the developing agent in the casing, the developing agent carrier configured to rotate about an axis extending in a first direction, the developing agent carrier being positioned between the first attachment portion and the second attachment portion;

a layer-thickness regulating member configured to regulate a thickness of a layer of the developing agent carried on the developing agent carrier; and

a first seal member disposed between the layer-thickness regulating member and the casing and is disposed to oppose the layer-thickness regulating member in a second direction perpendicular to the first direction, the first seal member extending along the first direction and directly contacting each of the first attachment portion and the second attachment portion, the first seal member including an upper side and a lower side, and the first seal member having an uncompressed length at

least as long as the distance between the inward-facing surfaces of the first attachment portion and the second attachment portion,

wherein the casing includes a plurality of third regulating portions spaced from each other configured to regulate a movement of the first seal member in a third direction perpendicular to the second direction and the first direction, and

wherein the third regulating portions contact the upper side of the first seal member,

wherein the plurality of third regulating portions are formed with upper ribs spaced from each other in the first direction, and

wherein the first seal member includes a plurality of upper protrusions protruding in the third direction and each of the upper protrusions is disposed between a pair of the upper ribs.

26. The developing device according to claim **25**,

wherein the first seal member directly contacts the casing and the layer-thickness regulating member without an adhesive material.

27. A developing device comprising:

a casing configured to store a developing agent, the casing including a first attachment portion and a second attachment portion;

a developing agent carrier configured to carry the developing agent in the casing, the developing agent carrier configured to rotate about an axis extending in a first direction, the developing agent carrier being positioned between the first attachment portion and the second attachment portion;

a layer-thickness regulating member configured to regulate a thickness of a layer of the developing agent carried on the developing agent carrier; and

a first seal member disposed between the layer-thickness regulating member and the casing and is disposed to oppose the layer-thickness regulating member in a second direction perpendicular to the first direction, the first seal member extending along the first direction, the first seal member including an upper side and a lower side, and the first seal member directly contacting at least one of the first attachment portion and the second attachment portion,

wherein the casing includes a plurality of third regulating portions spaced from each other configured to regulate a movement of the first seal member in a third direction perpendicular to the second direction and the first direction, and

wherein the third regulating portions contact the upper side of the first seal member,

wherein the plurality of third regulating portions are formed with upper ribs spaced from each other in the first direction, and

wherein the first seal member includes a plurality of upper protrusions protruding in the third direction and each of the upper protrusions is disposed between a pair of the upper ribs.

28. The developing device according to claim **27**,

wherein the first seal member directly contacts the casing and the layer-thickness regulating member without an adhesive material.

29. A developing device comprising:

a casing configured to store a developing agent, the casing including a first attachment portion and a second attachment portion spaced from each other in a first direction, the casing including a first seal support portion extending in the first direction and having a height direction, and a seal regulating portion having at least two sides of which at least one side is spaced from each of the first attachment portion and the second attachment portion;

a developing agent carrier configured to carry the developing agent in the casing, the developing agent carrier configured to rotate about an axis extending in the first direction, the developing agent carrier being positioned between the first attachment portion and the second attachment portion;

a layer-thickness regulating member configured to regulate a thickness of a layer of the developing agent carried on the developing agent carrier; and

a first seal member disposed between the layer-thickness regulating member and the first seal support portion of the casing and is disposed to oppose the layer-thickness regulating member in a second direction perpendicular to the first direction, the first seal member including a protrusion extending in the height direction and including an upper side and a lower side, the protrusion configured to contact at least one of the sides of the seal regulating portion to reduce movement of the first seal member relative to the first seal support portion,

wherein seal regulating portions spaced from each other configured to regulate a movement of the first seal member in a third direction perpendicular to the second direction and the first direction, and

wherein the seal regulating portions contact the upper side of the first seal member,

wherein the plurality of seal regulating portions are formed with upper ribs spaced from each other in the first direction, and

wherein the first seal member includes a plurality of upper protrusions protruding in the third direction and each of the upper protrusions is disposed between a pair of the upper ribs.

30. The developing device according to claim **29**,

wherein another of the seal regulating portion or the protrusion is on another side of the protrusion or the seal regulating portion, respectively.

31. The developing device according to claim **29**, further comprising:

another seal regulating portion having at least one side,

wherein the side of the another seal regulating portion is configured to contact the protrusion at a location separate from the side of the seal regulating portion.

32. The developing device according to claim **29**, further comprising:

another protrusion,

wherein the seal regulating portion has a second side spaced from each of the first attachment portion and the second attachment portion, and

wherein the another protrusion is configured to contact the second side of the seal regulating portion.

33. The developing device according to claim **29**,

wherein the first seal member directly contacts the casing and the layer-thickness regulating member without an adhesive material.

34. The developing device according to claim **29**,

wherein the seal regulating portion is configured to contact the first seal member to minimize movement in a second direction, the second direction being perpendicular to the first direction.

35. The developing device according to claim **34**,

wherein the protrusion of the first seal member is located on a portion of a first side of the first seal member,

wherein the seal regulating portion is a first seal regulating portion,

wherein the casing includes a second seal regulating portion positioned to contact at least a portion of a second side of the first seal member, such that the second seal regulating portion and the first seal regulating portion minimize movement of the first seal member in the second direction.

36. The developing device according to claim **35**,

wherein the first portion of the first seal member overlaps in the second direction at least the portion of the second side of the first seal member.

37. The developing device according to claim **35**,

wherein the first portion of the first seal member does not overlap in the second direction at least the portion of the second side of the first seal member.

38. The developing device according to claim **35**,

wherein the casing includes at least two first seal regulating portions, and

wherein the second seal regulating portion is positioned between the at least two first seal regulating portions in the second direction.

39. The developing device according to claim **35**,

wherein the first seal member includes a plurality of protrusions on both the first side of the first seal member and on the second side of the first seal member, and

wherein the casing includes a plurality of first seal regulating portions and a plurality of second seal regulating portions,

wherein one of the plurality of first seal regulating portions and the plurality of second seal regulating portions is configured to contact the sides of the protrusions in the first direction on a respective side of the first seal member while the other of the plurality of first seal regulating portions and the plurality of second seal regulating portions is spaced from the sides of the protrusions in the first direction on the respective side of the first seal member.

40. The developing device according to claim **34**,

wherein the protrusion of the first seal member is located on a portion of a first side of the first seal member, and

wherein the first seal member includes a second protrusion on a second side of the first seal member and the second protrusion is continuous along the second side of the first seal member.

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